Carbon Tracker
Initiative

Sense & Sensitivity:

Maximising Value with a 2D Portfolio

About Carbon Tracker

The Carbon Tracker Initiative is a team of financial specialists making climate risk real in today's financial markets. Our research to date on unburnable carbon and stranded assets has started a new debate on how to align the financial system with the energy transition to a low carbon future.

Acknowledgements

The report can be downloaded at: http://www.carbontracker.org/report/fossil-fuels-stress-test-paris-agreement-managed-decline/

Contents

O Executive Summary

2D stress tests

With the oil major AGM season now upon us, there are a number of resolutions calling for 2°C stress tests at the company level. This kind of exercise could feed into the system-level approaches that are being considered by the FSB Taskforce on Climate-related Financial Disclosures.

Carbon sensitivity

Continuing Carbon Tracker's focus on upstream capex for new oil and gas projects, we have developed a Carbon Sensitivity Analysis. This brings together low carbon demand scenarios with oil price and discount rate sensitivity to understand how reducing exposure to high cost, high carbon projects can optimise value. Given the unpredictability of oil prices, we believe that a sensitivity approach which incorporates a wide range of oil prices (including those that might be thought unlikely at the time) is valuable.

This analysis aims to show that it can make financial sense for the oil and gas majors to adopt a strategy of aligning their project portfolios to be consistent with a 2°C outcome, rather than pursue volume at all costs.

Value creation in a declining demand and production environment

The key comparison is the difference between the net present value (NPV) of a company's business as usual (BAU) asset portfolio and the low cost subset of that which is consistent with a 2°C warming demand scenario (2D), which implies lower oil production levels for the industry overall. This stress test takes the form of a sensitivity analysis looking at different oil prices and discount rates. The key question is: "Under which parameters is the NPV of the 2D project portfolio higher than that of the BAU project portfolio?"

This has crucial implications for owners who may be surprised at just how much value can be created by oil & gas companies in a carbon-constrained scenario.

2D stress test of new project capex

For the purposes of this exercise, we have examined the portfolios of the oil & gas majors in aggregate, treating them as a single entity. Compared with a BAU portfolio, the oil & gas majors as a group create more shareholder value by managing their future new upstream project developments to be consistent with a 2D demand level at all oil prices up to $120/bbl (in real terms in today's money, using a 10% discount rate).

Oil price bet

It would only make sense for a company to bet on approving new high cost projects that aren't needed under 2D if its management believed that oil prices would exceed $120 for significant periods of time. As reference points, OPEC's outlook averages around $80/bbl to 2040, and the WEO 2015 IEA450 scenario averages less than $100 to 2040. These outlooks would therefore not match the high price scenario required. With many commentators now discussing a longer term average oil price of $50-80, far below the levels needed to justify a BAU approach, constraining high cost investment certainly makes sense – as we have seen with the rush to cancel capex on uneconomic developments.

At current oil prices, we estimate that the portfolio of the combined majors' upstream assets would be worth c.$140bn more with investments restricted to 2D-compliant projects only (using a 10% discount rate). Even at $100/bbl, with no risk adjustment, their upstream assets are worth $55bn more under a 2D rather than BAU sanction approach.

For the purposes of this exercise, we have not attempted to look at any other assets the companies may have (for example midstream, downstream or other non-oil and gas interests). We have also not considered uses of capital – in some scenarios, a company with a smaller, lower-cost portfolio might well be able to return more capital to shareholders or invest it in other opportunities.

Dealing with volatility

Furthermore, companies that take a conservative view of project development and thus sanction lower cost projects should show less volatility in their valuations than higher cost companies. Their higher margins mean that cashflows and asset values are less sensitive to changes in oil price changes. Accordingly, they should be lower risk than companies that are less disciplined. Investors in lower risk assets accept lower returns than those in higher risk assets. This is why government bonds have lower yields than junk bonds.

The higher junk yield is needed to compensate for the higher risk of a failure to make interest payments or bankruptcy.

Fossil fuel risk premium

In much the same way, a high cost oil company has a greater risk of failing to pay a dividend or facing bankruptcy. As a result, investors wanting to correctly value low risk companies should use a lower discount rate than they would use for a high cost, high risk investment. Our analysis sets out a method by which a risk-adjusted discount rate or required return can be calculated. We call this the "fossil fuel risk premium" (FFRP) as it captures the risk associated with a company that invests in high cost projects.

2D stress test of upstream business model

We estimate that, for the majors collectively, the FFRP when applied to all projects (new and existing together) is 0.5% which is added to the standard 10% discount rate.

When this is applied to the full 2D and BAU portfolios of new and existing assets, the analysis suggests that the 2D portfolio outperforms the BAU portfolio at oil prices up to c.$180/bbl as shown in Figure A.

At $100/bbl, for example, the 2D portfolio's NPV is $115bn (or 11%) higher. We expect that the majority of existing oil and gas projects will be needed in a 2D demand scenario.

Our analysis confirms that the bulk of projects not needed under lower-demand scenarios are those yet to be developed—those where capital has not yet been sunk.

Figure A: Carbon Sensitivity of NPV of the majors to low demand, oil price and discount rate

Using a fossil fuel risk premium adjusted discount rate (10.5%) BAU becomes worth more than 2D at even higher oil prices

BAU becomes worth more than 2D at higher oil prices

Legend:
— 2D - 10% discount rate
— BAU (2D + unneeded under 2D) - 10% discount rate
- - - BAU - 10.5% discount rate

Y-axis: NPV of new and existing assets ($bn)
X-axis: Brent equivalent oil price (real $/bbl)
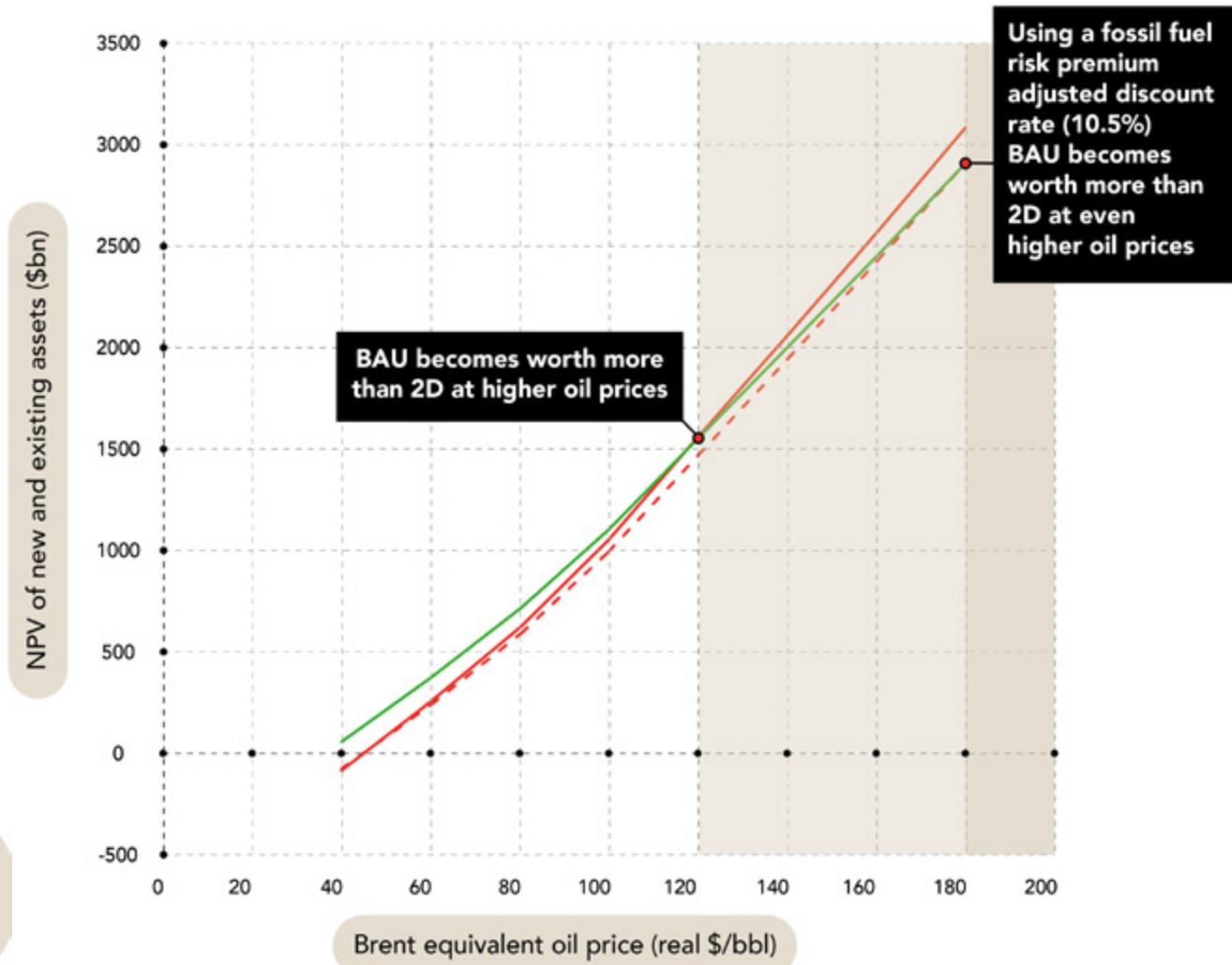
Source: Rystad Energy, CTI analysis

Higher significance at lower oil prices

Under low oil price scenarios, the difference in value is greater - making the choice of business model far more significant. For example, at $60/bbl, the 2D portfolio (of new and existing assets) has an NPV 43% higher than the BAU at a 10% discount rate. This relative uplift for the 2D portfolio falls to 15% at $80, and 5% at $100/bbl. So pursuing a BAU model is tantamount to a gamble on high oil prices.

Table A: NPV uplift of 2D portfolio compared to BAU portfolio (new and existing projects), 10% and FFRP adjusted discount rates

NPV uplift in 2D compared to BAU (%)	Oil price ($/bbl)							
	$40	$60	$80	$100	$120	$140	$160	$180
2D vs BAU (10% discount rate)	-	43%	15%	5%	0%	-3%	-5%	-6%
2D vs BAU (FFRP adjusted, 10.5% discount rate)	-	51%	21%	11%	6%	3%	1%	0%

Source: Rystad Energy, CTI analysis

Demand misread

From a business risk perspective, it makes sense for the industry to take a conservative view of long-term demand. Doing so would lower the risk of oversupply and hence weak prices, which destroy value - as we see in today's oil market.

From a risk assessment perspective, the industry also needs to be sure that it is not collectively overestimating demand, by dismissing future climate policy measures and underestimating rapid advances in technology. Believing in over-optimistic demand forecasts could lead the oil industry to expect the ever-higher oil prices needed to justify a BAU business model. But should demand undershoot those expectations, weak prices are likely to result.

Indeed, in the long term the worst-case scenario for shareholders could be for the oil price to recover without a greater culture of capital discipline being instilled, leading the industry to resume investing for growth on the assumption that ever higher demand lay ahead.

Commodity cycles

Under a low oil price scenario, the oil majors' existing production is likely to remain profitable. For example, we estimate that the average breakeven for existing production is around $40/bbl. It is the high cost future projects that risk destroying value. Many oil companies and commentators expect oil prices to rise relatively soon. And it is true that during periods of low oil prices, such as the current one, the decline rates of existing fields tend to increase. That should mean the market gradually self corrects. However, such a rebalancing will take longer in 2D rather than a BAU demand scenario because demand levels are lower.

The other side of the equation is of course supply. New projects are being put on hold which should also help correct the market. But with Saudi Arabia continuing to invest despite low oil prices and the revival in the oil industries of Iran and Iraq, this process may well take longer than some of the energy companies expect. A quick bounce back to the high oil prices seen before the recent collapse is by no means a safe bet.

Majors better positioned than other listed companies

The majors have a relatively strong position, because a large proportion of their assets are already producing and so are low cost. They also have new project options with a range of breakevens along the cost curve. However, smaller E&P companies which do not have significant existing production, and those which specialise in higher cost production (e.g. oil sands, deep water) may be more vulnerable.

2D stress test needed to understand potential for increasing shareholder value

The NPV calculations presented here show how sensitivity analysis can be a useful tool for risk management, specifically to understand the impacts of various price and demand scenarios. It may surprise many to find that the majors come out higher value if they align with a 2D scenario, unless oil prices move to historically unprecedented highs. This is why a number of shareholders are asking for this kind of analysis from the companies, to better understand their upstream business strategy.

1 Introduction

Is a 2D upstream portfolio worth more than a BAU one?

Value over volume

Carbon Tracker delivers financial research which makes the case for delivering the energy transition. One obvious question to ask is whether a smaller, lower cost portfolio of assets can generate more shareholder value than a larger range of projects which include higher cost options. The answer of course is – it depends. This paper explores some of the key variables using sensitivity analysis as a business stress test.

Risk management

The 2015 Carbon Tracker Blueprint[1] set out a risk management framework for oil and gas companies looking at climate and associated economic related risks. A key element of this was a 2D stress test of their business model, looking at planning and

governance processes from a shareholder's perspective. It was not a financial stress test of their whole business as would be the case, for example, in the banking industry. However, this kind of carbon stress test is a part of the puzzle that is currently being considered by various financial regulators, including the FSB Taskforce on Climate-Related Financial Disclosures.[2] It is also one of the tools that is identified as warranting further development by the UNEP Inquiry into a Sustainable Financial System.[3]

Capital discipline

In this note, we set out a methodology for comparing the relative values of a company's portfolio of upstream fossil fuel assets on a business as usual (BAU) basis with a portfolio that is consistent with a 2D demand outcome. The latter means

fewer (and lower cost) projects need to be developed. Our stress test of the industry's business model uses sensitivity analysis to 'stress' existing and future projects enabling us to look at their risk profiles. It is a bottom up approach comparing two scenarios, mirroring our previous focus on capital expenditure, rather than an assessment of organizational viability.

NPV analysis

The two possible portfolios (BAU and 2D) are compared using one simple value metric – net present value (NPV). This is a core measure of value generated by future cash-flows from upstream assets. We do not attempt a valuation of any midstream, downstream, or other non-upstream oil and gas assets. In that sense, this is not an industry wide test as it does not capture any non-upstream diversification. This report does not look at alternative uses of

1	http://www.carbontracker.org/report/companyblueprint/

2	https://www.fsb-tcfd.org/
3	http://apps.unep.org/publications/index.php?option=com_pub&task=download&file=011830_en

cash flow such as increased dividends and buybacks or diversification into renewables. But following a 2D strategy would enable management to investigate such strategies over the medium term. Some investors might see these as part of the strategy for managing a decline in fossil fuel demand in the fullest sense.

> The key comparison in this report is between the NPV of a company's BAU asset portfolio and that of a low cost subset which is consistent with a 2D demand scenario. The sensitivity analysis looks at how the portfolio valuations change with varying oil prices. The key test is the following: "under what circumstances is the NPV of the 2D project portfolio higher than the NPV of the BAU project portfolio?"

Estimating Fossil Fuel Risk Premium (FFRP)

One refinement in our analysis is that the relative change in portfolio value to changes in oil price can be used as a measure of volatility.

We assume that the implied valuation of a group of oil majors will move in line with our estimate of NPV. The more volatile the change in NPV for a given move in the oil price, the riskier the investment. Investors quite rightly demand a higher return for taking higher risks – hence the difference in yields for junk bonds and government bonds. The oil industry equivalent of a junk bond, a company with high costs and hence high volatility is more likely to cut dividends or even enter bankruptcy than is a low cost company. Our analysis shows that the BAU portfolio has greater sensitivity to oil prices than 2D, and thus greater risk. Accordingly, investors in a BAU portfolio should demand a higher return than from a 2D portfolio in order to be compensated for the higher risk. In calculating the NPV of such assets, investors would use a higher discount rate to reflect the additional risk. We see the difference between the required return (or discount rate) for the 2D and BAU portfolios as the "fossil fuel risk premium" (FFRP).

Reasonable request

We have completed this research in order to demonstrate what is feasible. Oil companies have much larger resources and teams of analysts, economists, and scenario teams. It also appears that the type of companies covered in this report already conduct this kind of analysis internally.

For example, Exxon states in its 2016 Proxy filing in response to a request for shareholders for a 2degree analysis that:

"We also financially "stress test" our investment opportunities, which provides an added margin against uncertainties, such as those related to technology development, costs, regulation/legislation, geopolitics, availability of required materials, services, and labor. Stress testing, which differs from alternative scenario planning, further enables us to consider a wide range of market environments in our planning and investment process."[4]

Given that Exxon states that it already stress test investment opportunities against a wide range of technology and regulation uncertainties, we consider it a reasonable request that a 2D scenario is part of that and the results are shared. This does not mean that the company has to consider the scenario likely – reviewing alignment with what the industry consider the highest probability scenarios is not the purpose of conducting a stress test.

4   http://cdn.exxonmobil.com/~/media/global/files/investor-reports/2016/2016_Proxy_Statement.pdf

2 A 2D stress test for upstream
The value of future project options

Methodology

In our November 2015 "Danger Zone"[5] analysis we called for a stress test of business models based on 2D demand levels, which would demonstrate the comparative value of a smaller, lower-cost portfolio of future projects. To demonstrate this, we look at the NPV of the aggregate portfolios of upstream assets held by the seven majors (ExxonMobil, Shell, BP, Chevron, ConocoPhillips, Eni and Total).

At the upstream level, our results indicate that these companies could successfully manage a potential decline in demand by adopting a more conservative approach to future projects. Continued new investment will be needed even in the reduced portfolio, but less than under a business-as-usual scenario. Although demand for oil under the IEA's 450 Scenario ultimately falls to 74mbd by 2040, the overall rate of production from existing fields will naturally decline at a faster rate than demand.

5   http://www.carbontracker.org/report/stranded-assets-danger-zone/

This decline will need to be offset by some additional sources in order to satisfy energy needs.

The four fundamental inputs we focus on are those that dominate most debates about the future of energy:

•   **The demand pathway** consistent with an outcome that limits global warming to 2°C (2D). Arguably there could be many variants of fossil fuel mix between oil, gas and coal. As a reference point we have used the IEA 450 scenario (a 2D demand pathway); if a company has their own preferred scenario they could state this, provide the details, and test it as a variant. However, it is important that the underlying assumptions are transparent.

•   **The potential supply curve** - we continue to use the approach we have used in our Carbon Supply Cost Curves series over the past 2 years: a global supply curve of all projects in the Rystad UCube database as per Rystad's base case, ranked by relative breakeven cost on the premise

that lower cost projects will be able to outcompete their high cost counterparts in a given demand scenario. We have referred to this as a BAU supply curve which reflects industry views on potential supply. Note that the curve therefore does not contain the full supply potential of the global oil industry, but rather Rystad's estimate of what might go ahead.

•   **The oil and gas price** used to calculate cash flows. For this exercise we have used stable real oil prices in today's dollars looking forward. The Rystad database generally assumes that gas prices move in line with oil prices. The ratio between oil and gas is set on a regional basis.

•   **The discount rate** used to discount future cash flows into today's value. To calculate a reference "break even price" (BEP), we use a fixed 10% discount rate, which is fairly standard in the oil industry. The BEP is the oil price at which a project has a NPV of zero – this the oil price needed for a project to deliver a 10% return

(increasing the discount rate would increase the BEP). However, when valuing the portfolios via NPV analysis, we adjust this discount rate to take risk into account. The higher risk a portfolio of assets is, the higher the discount rate we use. One wouldn't use the same discount rate to value a virtually risk free asset such as a government bond and a high risk asset such as a junk bond. The same should be true for oil companies. We call this adjustment, which takes in to account the risk to the project portfolio from oil prices moves, the Fossil Fuel Risk Premium (FFRP).

Demand & Supply

In our previous Carbon Supply Cost Curves analysis, we have used a cost-based approach to determine those projects which are compliant with 2D (the lower cost projects that are needed to meet the 2D demand level) and those that are not (the higher cost projects that represent potential supply above the level needed for 2D demand).

Firstly, a cost curve of potential supply under Rystad's base case is established, lining up potential sources of production in order of cost with the lowest cost options on the left.

This chart of potential supply represents global supply on a BAU basis; note that it does not represent the full maximum possible supply capacity, but rather than portion that might go ahead under Rystad's base case.

In order to establish the 2D-compliant part, the demand potential demand pathway for 2D is then drawn on this chart (shown as a vertical line in Figure B). The lower cost projects to the left of the line are those that will be needed to satisfy demand; the high cost potential projects to the right of this line will not be.

Figure B: Illustrative global liquids supply curve

Supply curve (10% discount rate)
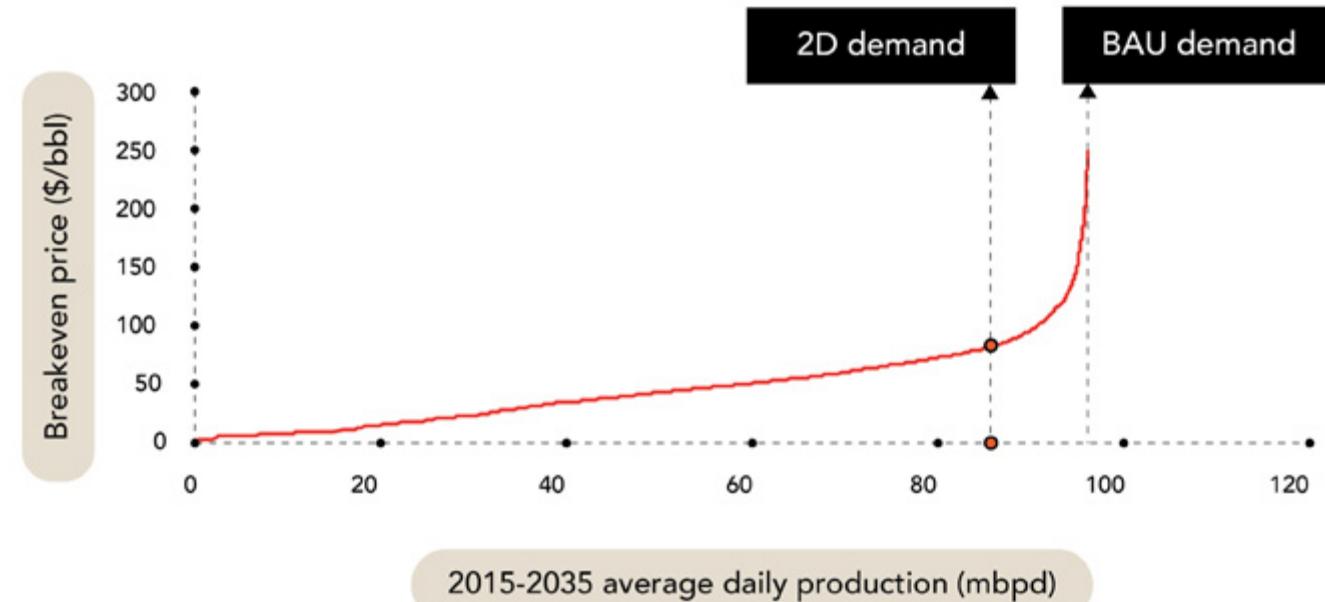
Once the global supply picture has been divided in this way, an individual company can be selected and their portfolio reviewed to see which projects in it are 2D compliant and which are not. We have used this approach to derive two possible portfolios for valuation:

- **BAU portfolio** - all projects available to the majors under Rystad Energy's base case are assumed to be developed; and
- **2D portfolio** – only those projects available to the majors and needed to satisfy demand in the IEA's 450 scenario.

As the 2D portfolio is a subset of the BAU portfolio, the BAU portfolio can alternatively be thought of as (a) the 2D portfolio plus (b) incremental projects which are assumed to go ahead but are not needed to meet 2D demand. We call these "unneeded" projects.

We also subdivide these two portfolios into:

- **new assets only** (discovery or undiscovered stage), i.e. excluding assets that are already producing or under development; and
- **all assets**, i.e. including both new and existing assets. This helps us to see where the risk is in the project portfolio.

Price ranges

Future oil and gas prices are impossible to predict with consistent accuracy, so we believe it is not possible to reliably say what the oil price would be under a 2D (or BAU) scenario. But it is possible to stress test a project portfolio by conducting a sensitivity analysis using wide range of prices. Some elements of this range might be thought unlikely, but that is what stress tests are for. For our analysis, we use a flat real oil price. We could have used a variable price by using the futures curve or an industry forecast but that would mean that the BEPs and valuations would be far less useful to investors.

The NPVs of the free cash flows of the two portfolios are then calculated at a range of different oil prices, from $40-180/bbl, where the given oil price is assumed to be flat in real terms from 2016 onwards. Breakeven oil prices are in Brent-equivalent terms. This is a broader range than many would have used a couple of years ago, before this new period of volatility. For example, Shell indicated in 2014 that they used a planning assumption for real oil prices (Brent) of $70-110/bbl. At the time, the oil price was over $100/bbl but the events of 2015 quickly exposed the weakness of using such a narrow planning range. We use flat real oil prices in our analysis in the same way that many in the industry do (including Shell).

The industry may well say that it would not knowingly sanction a project with a negative return under its planning assumption. But the oil market is often volatile and the actual outcome for prices may well be materially different from the planning assumption at the point of sanction. After all, the industry was comfortable sanctioning projects in 2013 that had breakeven prices well above $80. Within two years, these "comfortable" projects faced multibillion dollar write-downs as the oil price plunged. In some cases, projects already under development were cancelled – a good example is Shell's Carmon Creek project which was cancelled in October 2015 at a cost of $2bn.

Discount rates

In our previous work we have frequently used 10% as a discount rate to calculate the oil price at which a project covers its financing costs (the "breakeven price"). This discount rate is fairly common in the industry. Indeed, it is used by oil companies to calculate the value of their oil and gas reserves in US filings. It is also close to the industry's weighted average cost of capital (WACC). While it is not an exact tool, in that it does not incorporate differences in WACC from company to company or other factors that may vary from project to project (for example in-country political risk), it provides a reasonable basis for calculating breakeven prices which allow us to compare the economics of different projects on a consistent footing.

In this paper, we calculate the NPVs of different portfolios, also using a discount rate. For this exercise, we take the further step of adjusting the discount rate used to calculate the NPVs in order to reflect the greater risk of more volatile/lower-margin projects. This can be thought of as a slightly more precise use of the discount rate, in that it begins to more incorporate the differing risk profiles of different portfolios, rather than being a purely comparative tool.

Sanction price

It is further important to distinguish the concepts of a discount rate used for NPV or breakeven calculation from the hurdle return rate that would be required in order for a company to sanction a new project. Although a 10% discount rate might be appropriate for calculating net present values of existing projects (assuming conservative oil price assumptions) or breakevens, we would be concerned if a company sanctioned a new project on the basis of an assumed 10% return. This is because new projects carry additional risks including possible delays, tax changes, and cost overruns. Project lead times also mean they are exposed to additional oil price risk during development. This means that new projects are inherently more risky than existing fields. Accordingly, we would regard using a 10% hurdle rate for sanctioning new projects as financially imprudent, and would expect that a company would demand a higher expected rate of return before allowing a new project to go ahead.

Applying a Fossil Fuel Risk Premium

Companies that assume high future demand will deliver ever higher oil prices run the risk of sanctioning relatively high cost projects. A business model that relies on high oil prices is clearly higher risk than one that takes a more conservative view. It is for this reason that we believe that a low risk 2D business model should be valued using a lower discount rate than a BAU model. This reflects its lower cost and hence lower volatility in its valuation for a given move in the oil price. It is a market truism that risk goes hand in hand with volatility. We refer to the gap between the 2D and BAU discount rates as the Fossil Fuel Risk Premium. We estimate this to be 0.5% in this case. When valuing the higher risk BAU portfolio, we add this to the standard 10% we use to value the 2-degree portfolio.

3 2D NPV sensitivity analysis
Stress testing capex

Capex stress test

Carbon Tracker has identified the capex plans of the fossil fuel extraction sectors as an area of focus for a number of years. The drop in the oil price seen over the last eighteen months or so has acted as a real-time price test for capex decisions, which saw around $380bn of capex deferred by the oil and gas sector between late-2014 and the end of 2015.[6]

Figure C: NPV of new assets at the seven oil & gas majors ($bn)
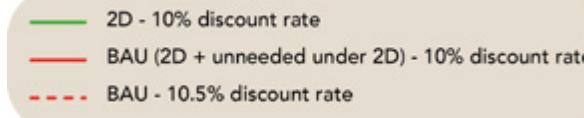
Source: Rystad Energy, CTI analysis

New project options

Figure C shows the NPVs of cash flows at different oil prices over the period 2016-2050 for new projects (discovery and undiscovered) from the Rystad database that are in the portfolios of the majors. This analysis excludes those already producing or under development.

We focus on these as it is primarily new projects that are unneeded in a 2°C demand world. Existing production is generally lower cost as the necessary capital has already been sunk. New projects tend to be higher cost and are easier to cancel than those already under development.

Legend:
- 2D - 10% discount rate
- BAU (2D + unneeded under 2D) - 10% discount rate
- BAU - 10.5% discount rate

Labels on chart: "BAU becomes worth more than 2D at higher oil prices", "Portfolio breakevens"

Y-axis: NPV of new assets ($bn)
X-axis: Brent equivalent oil price (real $/bbl)

6   http://www.woodmac.com/media-centre/12530462
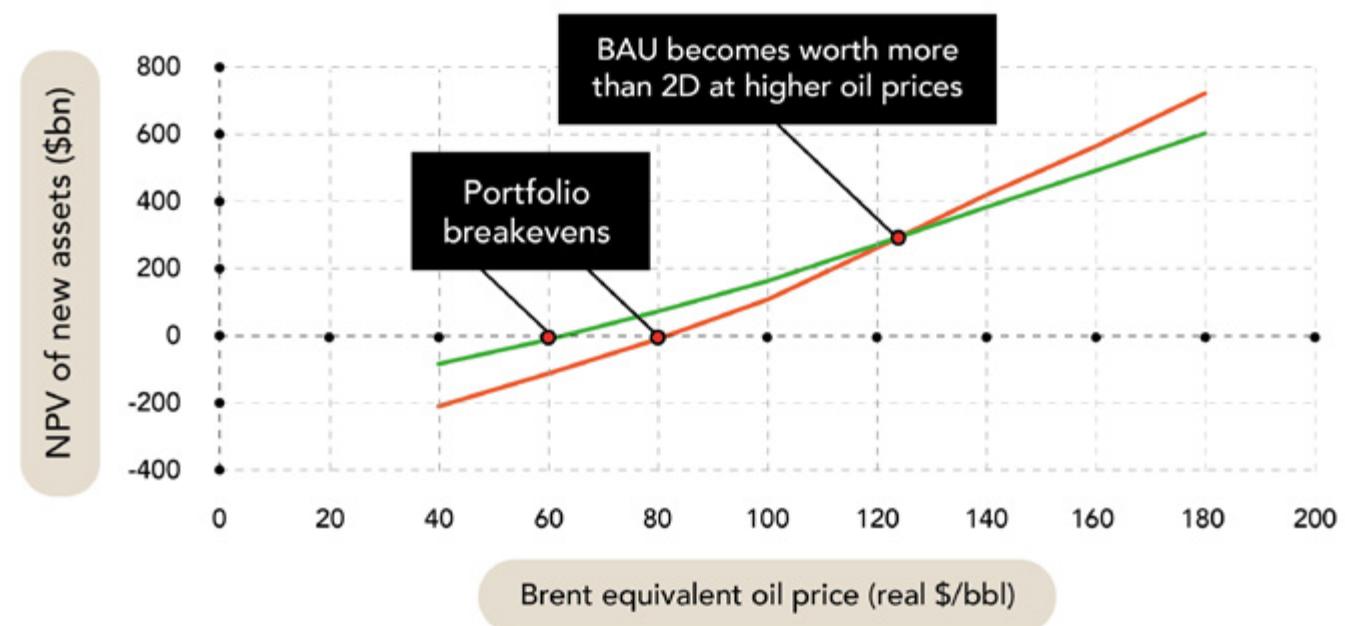
Oil price sensitivity

At a 10% discount rate, the 2D portfolio has a breakeven price (i.e. has an NPV of 0) of c.$60/bbl, compared to c.$80/bbl for BAU. In other words, it is hard to see majors making acceptable returns on new projects under either 2D or BAU scenarios until the oil price increases significantly from current levels. Note that producers can usually still generate cash from existing projects as the cash costs of production can be $40/bbl or less. But new projects must be able to cover capital costs as well.

Figure C indicates the different gradients of the NPV lines for each scenario. The BAU is more sensitive to price as it is steeper, i.e. for a given change in oil price the NPV of the BAU portfolio changes more (either up or down) than that of the 2D portfolio.

However, the two lines do not cross until around $120/bbl. This means that the 2D portfolio of new projects delivers a higher NPV than the BAU at oil prices up to c.$120/bbl in real terms. In other words, the unneeded projects need oil prices to average $120/bbl over their lifetime before they have a higher NPV in the BAU scenario than in the 2D scenario.

This simply reflects the relatively high break evens of the type of projects that are required under BAU, some of which are not economic until oil prices reach $100+/bbl.

The degree to which many possible new projects are out of step with the current oil price environment is clearly illustrated by the extent to which companies have frantically cancelled capex on future developments.

Companies therefore need to believe in sustained oil prices at far higher levels than they are today in order for the unneeded projects to breakeven in aggregate. As a reference point, $120/bbl (in real terms) is around $40 above the average OPEC oil price outlook to 2040.

Accordingly, under the OPEC oil price outlook, the majors as a group would be better off adopting a 2D demand outlook in their sanction decisions.

Full tables of sensitivities to oil price and discount rate/IRR are shown in the appendix.

——— OPEC assumption (OPEC reference basket)

——— IEA 450 scenario

Figure D: Oil price assumptions, OPEC and IEA 450 scenario
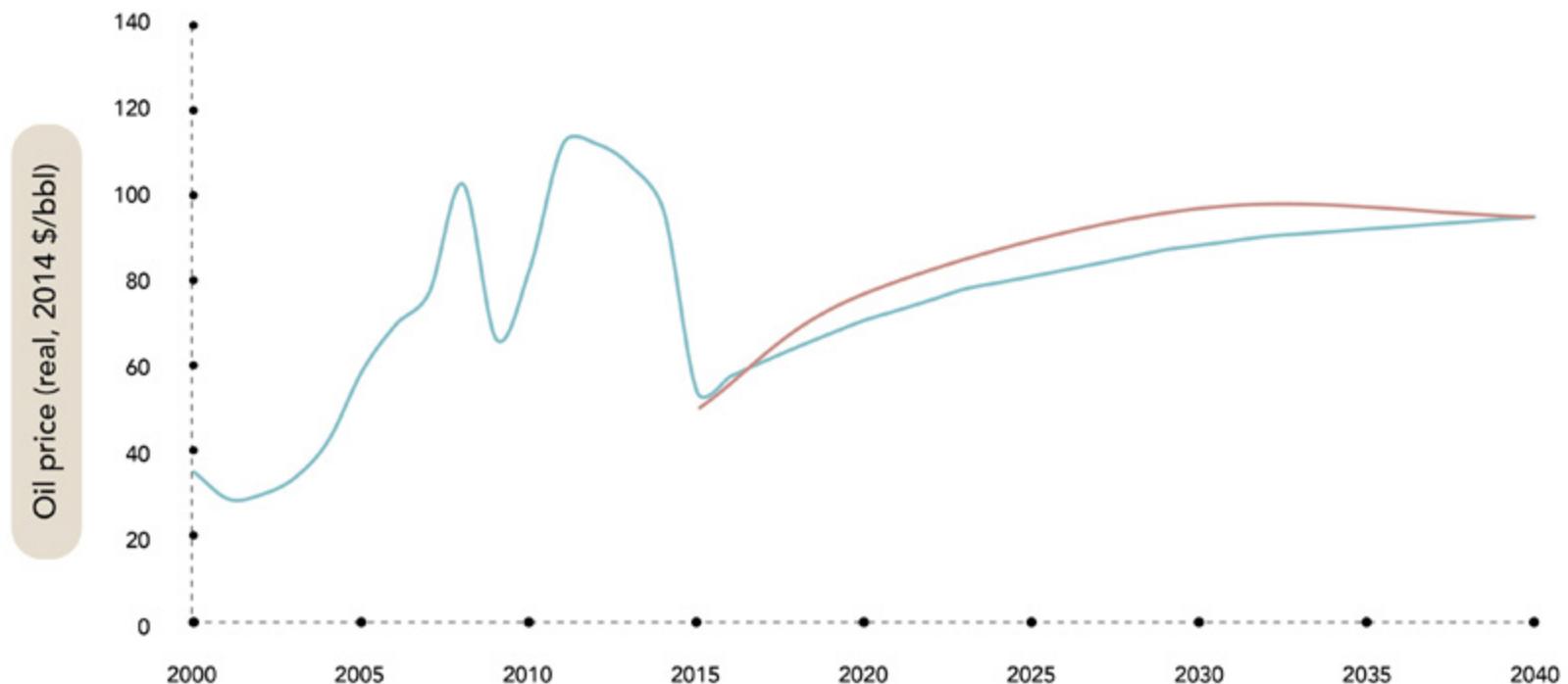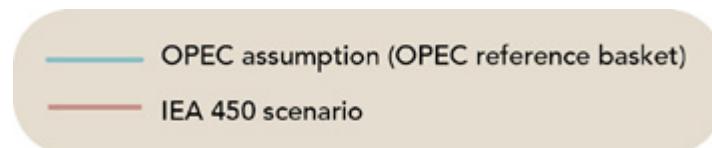
Source: OPEC World Oil Outlook 2015, IEA World Energy Outlook 2015

Discount rate sensitivity

By imagining the portfolios of the majors collectively, we can take the analysis a step further. The discount rate of 10% used here is an approximation of the weighted cost of capital (WACC), which (as the name implies) is a weighted average of the cost of debt and cost of equity adjusted for the industry's financial structure.

Cost of capital

Theoretically, a lower risk company should have a lower cost of capital. Investors must weigh up the return that they expect from an investment with the risk that they would be taking on. In order to justify taking on a higher risk, they will demand a greater return on their investment through a higher yield on equity or higher coupons on bonds. To deliver that, a risky company will have to generate a higher return on its assets. This means that investors in a higher risk company should use a higher discount rate when calculating the NPV of their potential investment.

Fossil fuel risk premium

A key input to calculating the appropriate discount rate is risk. Traditionally, investors have used past volatility in share prices as a surrogate measure of risk. High volatility implies high risk. But this is rearward looking. We have used the sensitivity of the NPVs to movements in oil prices as a forward-looking alternative. The NPV of the 2D portfolio is 10% less sensitive to movements in the oil price so it is 10% less risky. Taking this into account, we can calculate the appropriate risk-adjusted discount rate. We call this difference in cost of capital between our two scenarios the fossil fuel risk premium and we estimate it to be 0.5%. It reflects the higher cost base and hence risk of the BAU portfolio.

2D NPV sensitivity analysis
Stress testing upstream business model

Upstream business model

We now look at the NPV of the entire upstream project portfolio of the majors, including existing and new projects yet to be developed. This can be seen as a business model stress test. Figure A shows that the BAU portfolio has a break-even price of around $45/bbl, the 2D portfolio just under $40/bbl.

Figure A: Carbon Sensitivity of NPV of the majors to low demand, oil price and discount rate

Legend:
- 2D - 10% discount rate
- BAU (2D + unneeded under 2D) - 10% discount rate
- BAU - 10.5% discount rate

Source: Rystad Energy, CTI analysis
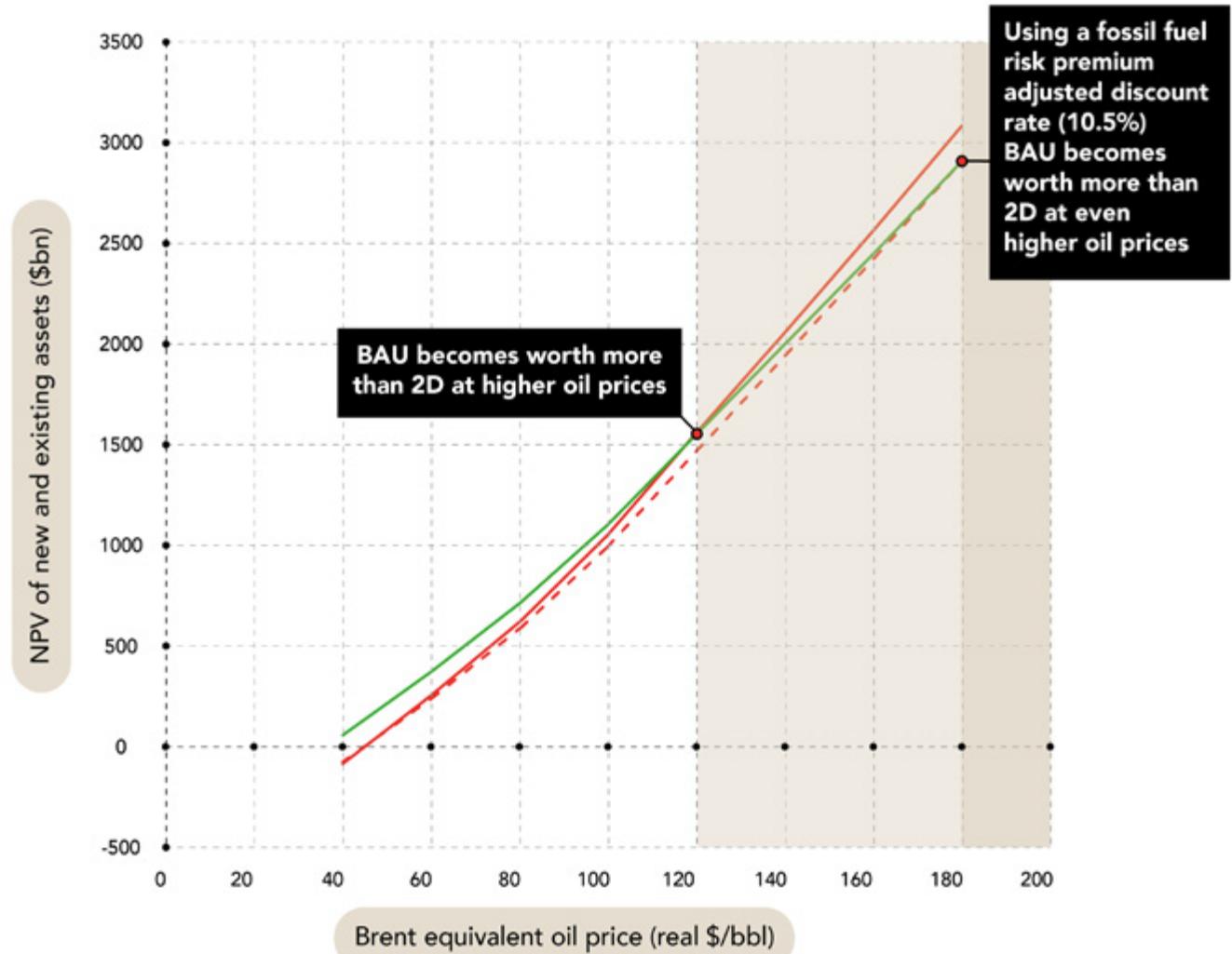
Chart annotations:
- Y-axis: NPV of new and existing assets ($bn)
- X-axis: Brent equivalent oil price (real $/bbl)
- "BAU becomes worth more than 2D at higher oil prices"
- "Using a fossil fuel risk premium adjusted discount rate (10.5%) BAU becomes worth more than 2D at even higher oil prices"

As virtually all existing production is required in a 2D demand scenario, the existing asset portions of the 2D and BAU portfolios are substantially the same. Accordingly, as new assets are the only material differentiating factor, the point at which BAU has more value than 2°C is similar to that we calculated for new projects, around $120/bbl. The existing assets also represent the majority of value, meaning that the 2°C and BAU lines are closer together than for new assets only. Hence, both portfolios need oil prices in excess of $40/bbl to create any material value.

Fossil fuel risk premium

If we use the same discount rate for both models, the crossover point is around $120/bbl. But if we apply the FFRP of 0.5% to the BAU portfolio (the dotted line), the breakeven price rises to around $180. This means that the 2D business model, when risk-adjusted, is superior to BAU unless oil prices rise to levels that have never been seen before, i.e. more than double the OPEC outlook average to 2040.

Higher significance at lower oil prices

Under a low oil price environment, such as the one the industry is currently enduring, the 2D business model is clearly superior. For example, at $60/bbl, the 2D portfolio has an NPV 51% higher than the BAU when risk adjusted using the FFRP. This relative uplift for the 2D portfolio falls to 21% at $80, and 11% at $100/bbl.

5 Conclusions

Major surprise

The oil and gas majors have a range of options along the supply cost curve. Our analysis has shown that by not approving the new high cost options going forward, they could create more shareholder value than by pursuing all options at all costs. Maintaining such capital discipline, even if oil prices rebound for a time, will be essential to optimising value. At current oil prices, we estimate that the portfolio of the combined majors' upstream assets would be worth c.$140bn more with investments restricted to 2D-compliant projects only (using a 10% discount rate). Even at $100/bbl, with no risk-adjustment, their upstream assets are worth $55bn more under a 2D rather than BAU sanction approach.

Fossil fuel risk premium (FFRP)

The additional risk premium attributable to high cost fossil fuel assets that are not needed under a 2°C world can be calculated, and used to quantify how risk can affect the valuations of asset portfolios. Should the majors follow a 2D consistent approach rather than a BAU strategy which includes higher cost projects in a larger portfolio, we estimate that with the FFRP applied, they would be worth around $115bn more even at $100/bbl oil.

Resolution resolution

A number of the resolutions filed with oil and gas companies this year relate to conducting some kind of 2°C stress test.

This simple sensitivity analysis on upstream projects provides one option as to how companies could start to provide more meaningful quantified information on the impacts (positive or negative) of pursuing different capex strategies. This can then be developed further using their own internal information to consider the full impact on the organization including downstream, and most significantly for shareholders - dividends. This upstream test is only one part of a larger jigsaw puzzle that would be required to map out risk across the financial and energy systems.

Offsetting decline

Although we believe that demand for their products may undershoot optimistic industry expectations, this does not mean that all oil & gas companies should stop producing instantly or that investors in the sector are financially doomed as some assume. Additional investment will be needed for some time to come in order to offset the natural declines of producing fields.

However, we believe that the best results for investors can be delivered by oil and gas company boards and executives managing their companies as if preparing for lower demand levels, whether they personally expect them or not. They should let other companies take the risk on high cost marginal developments. By using sensitivity analysis in this manner, we can see that prudent capital expenditure can enhance shareholder value.

Beware the demand misread effect on oil prices

Recent market dynamics have shown how a relatively small mismatch between demand and supply (around a 2% oversupply in the current case) can result in significant market volatility and periods of lower prices. Pursuing a BAU strategy in a scenario where demand undershoots industry expectations leaves the development portfolio open to the risk of further oil price weakness. The behaviour of the oil price during the crashes of 1986, 2008 and 2015 suggests that the industry finds it difficult to coordinate its actions in order to counter weak prices.

Not surprisingly, individual companies have little influence over price behaviour. It is important therefore that management teams assess the risk of such events – something they have singularly failed to do in the past.

Wider implications

The majors have a relatively strong position, due to having a large proportion of assets already in production and new project options with a range of breakevens along the cost curve. It is important, however, that they exercise capital discipline and avoid sanctioning high cost assets – as some started to do over the past five years. E&P companies which do not have significant existing production, and companies which specialise in higher cost production, (e.g. unconventionals, deepwater), will be more vulnerable.

Price point

Unless future oil prices climb to high levels and remain there on a sustained basis, shareholder value is maximised with a strategy where decisions are made as if future demand will be lower than BAU scenarios, and upstream portfolios are streamlined accordingly with a focus on low cost, low risk production. Indeed in lower oil price scenarios, there is significant upside to pursuing a 2D asset portfolio. Only in scenarios with average prices above $100/bbl, does the gap start to close. On a risk adjusted basis, the gap does not close until oil prices reach $180/bbl, a level they have never previously achieved, much less sustained over the long term.

Appendix A – Sensitivity tables

NPV sensitivity tables - new assets only

Table B. Majors NPV of new assets ($bn) - 2D portfolio

		Brent-equivalent oil price ($/bbl)							
		40	60	80	100	120	140	160	180
	9.0%	-82	8	110	213	344	475	605	736
	9.5%	-81	1	95	189	309	429	549	669
Discount rate (%)	10.0%	-80	-5	81	168	278	388	498	608
	10.5%	-79	-11	68	148	250	351	452	553
	11.0%	-78	-15	57	131	224	317	411	504
	11.5%	-77	-19	47	115	201	287	373	459

Table C. Majors NPV of new assets ($bn) - BAU portfolio (2D + unneeded under 2D)

		Brent-equivalent oil price ($/bbl)							
		40	60	80	100	120	140	160	180
	9.0%	-224	-103	26	167	352	538	723	908
	9.5%	-215	-106	10	139	308	477	647	816
Discount rate (%)	10.0%	-207	-108	-3	114	268	423	578	733
	10.5%	-199	-110	-15	91	233	375	517	659
	11.0%	-191	-111	-26	72	202	332	462	592
	11.5%	-184	-111	-35	54	174	293	412	531

NPV sensitivity tables - new and existing assets

Table D. Majors NPV of new and existing assets ($bn) - 2D portfolio

		Brent-equivalent oil price ($/bbl)							
		40	60	80	100	120	140	160	180
	9.0%	71	419	799	1,230	1,733	2,236	2,739	3,241
	9.5%	67	398	759	1,168	1,643	2,118	2,593	3,068
Discount rate (%)	10.0%	63	378	722	1,110	1,560	2,010	2,459	2,909
	10.5%	60	361	688	1,057	1,484	1,910	2,336	2,762
	11.0%	57	344	656	1,008	1,413	1,818	2,222	2,627
	11.5%	54	329	627	962	1,347	1,732	2,117	2,502

Table E. Majors NPV of new and existing assets ($bn) - BAU portfolio (2D + unneeded under 2D)

		Brent-equivalent oil price ($/bbl)							
		40	60	80	100	120	140	160	180
	9.0%	-87	296	707	1,182	1,754	2,327	2,899	3,471
	9.5%	-82	280	667	1,115	1,654	2,193	2,731	3,270
Discount rate (%)	10.0%	-78	265	630	1,054	1,562	2,070	2,578	3,086
	10.5%	-74	251	597	998	1,477	1,957	2,437	2,917
	11.0%	-70	238	566	946	1,400	1,854	2,307	2,761
	11.5%	-66	227	537	899	1,329	1,759	2,188	2,618

Appendix B - Calculating the Fossil Fuel Risk Premium

One method of calculating cost of capital is to use the Capital Asset Pricing Model (CAPM). This takes into account the risk free rate (typically defined as long-term government bonds), the equity risk premium (the additional return investors demand from equities because of their higher risk), the proportion of the business that is funded from debt and beta (a measure of company specific risk relative to the market.)

The cost of debt is typically taken as the yield to maturity of a company's long-term debt, if any has recently been issued.

The cost of equity can be worked out using the capital asset pricing model (CAPM), which is where the higher volatility has an impact. According to this model, the theoretical cost of equity for a listed company is given by:

> **Required/expected return on asset = risk free rate + beta x (expected market return – risk free rate)**

Where:

Risk free rate = the rate expected by an investor on a risk-free investment
Beta = a measure of risk relative to the market
Expected market return = the rate expected by an investor on the market

Typically, risk relative to the market is measured by a stock's beta. This is normally calculated by looking at a share's past returns relative to those of the market. The market's beta is defined as 1. If a company returns are more volatile than those of the market, it will have a beta above one. If they are less volatile, it will be less than one. For example, a stock that delivers returns 20% less volatile than those from the market will have a beta of 0.8.

One disadvantage with beta as a measure of risk (or volatility) is that it is rearward looking. For example, a low risk utility might have a historic beta of 0.8 but if it suddenly announced that it was diversifying into nuclear reprocessing or deep-water exploration in the Arctic, it is likely that shareholders would perceive it has higher risk. The historic beta would not capture this additional risk until sometime in the future, once the share price became more volatile.

We have chosen to use oil price sensitivity as a measure of risk – a surrogate beta. The oil price is probably the single most important driver of value in the oil industry. We assume that the market value of an oil company will move in line with its net present value. As the oil price rises, the share price would rise as it tracks the NPV. We believe this to be a more useful measure of volatility and risk than a rearward looking beta calculated using historic prices. In our analysis, the slope of the NPV chart can be seen as a measure of volatility and hence risk. The greater the slope, the greater the change in NPV for a given move in the oil price.

Our sensitivity analysis shows that the 2D portfolio has a gradient around 90% of that for the BAU portfolio. If the share price of a 2D portfolio tracks the change in NPV, which is logical, it would have a beta of 0.9 compared to 1.0 for the BAU portfolio. If we assume an expected market return of 9% (approximating the long term average return of the S&P index), a risk free rate of 2.5% (approximating the yield on long term US Treasury bonds), and 79% equity funding, we can show that a BAU portfolio will have a cost of capital 0.5% above that of the 2D portfolio.

Accordingly, the BAU portfolio is given a FFRP of 0.5%, producing a discount rate of 10.5% compared to 10% for 2D.

For more information visit www.carbontracker.org and follow us @CarbonBubble

DISCLAIMER

Initiative
Carbon Tracker